

WHAT IS CLAIMED IS:

1. A plasma processing method for generating plasma within a vacuum chamber and processing a substrate placed on a substrate electrode within the vacuum chamber, the method comprising:

generating the plasma by supplying a high-frequency power having a frequency of 50 MHz to 3 GHz to a counter electrode provided opposite to the substrate while interior of the vacuum chamber is controlled to a specified pressure by introducing gas into the vacuum chamber and, simultaneously therewith, evacuating the interior of the vacuum chamber; and

processing the substrate by using the generated plasma while plasma distribution of the plasma on the substrate is controlled by an annular, groove-like plasma trap provided opposite to the substrate.

2. A plasma processing method for generating plasma within a vacuum chamber and processing a substrate placed on a substrate electrode within the vacuum chamber, the method comprising:

generating the plasma by radiating electromagnetic waves into the vacuum chamber via a dielectric window provided opposite to the substrate by supplying a high-frequency power having a frequency of 50 MHz to 3 GHz to an antenna while interior of the vacuum chamber is controlled

8. A plasma processing method according to Claim 1, wherein the plasma is generated while the plasma trap is provided between the counter electrode and an insulating ring for insulating the vacuum chamber and the counter electrode from each other.

9. A plasma processing method according to Claim 1, wherein the plasma is generated while the plasma trap is provided between the vacuum chamber and an insulating ring for insulating the vacuum chamber and the counter electrode from each other.

10. A plasma processing method according to Claim 2, wherein the plasma is generated while the plasma trap is provided in the dielectric window.

11. A plasma processing method according to Claim 2, wherein the plasma is generated while the plasma trap is provided outside the dielectric window.

12. A plasma processing method according to Claim 2, wherein the plasma is generated while the plasma trap is provided between the vacuum chamber and the dielectric window.

13. A plasma processing method according to Claim 1, wherein the plasma is generated while DC magnetic fields are absent within the vacuum chamber.

14. A plasma processing apparatus comprising:
a vacuum chamber;

a high-frequency output terminal; and
a second reactive element having one end
connected to the high-frequency input terminal and the
other end connected to the high-frequency output terminal,
5 wherein the second reactive element and the high-
frequency output terminal are so arranged that the second
reactive element is located on a straight line passing
through a center axis of the high-frequency output terminal.

31. A matching box for a plasma processing apparatus
10 according to Claim 30, wherein the second reactive element
and the high-frequency output terminal are so arranged that
a straight line passing through a center axis of the second
reactive element and a straight line passing through the
center axis of the high-frequency output terminal are
15 generally coincident with each other.

32. A matching box for a plasma processing apparatus
according to Claim 30, wherein the first reactive element
and the second reactive element are capacitors,
respectively.

20 33. A matching box for a plasma processing apparatus
according to Claim 30, wherein the first reactive element
and the second reactive element are so arranged that a
straight line passing through a center axis of the second
reactive element and a straight line passing through a
25 center axis of the first reactive element are generally

coincident with each other.

34. A matching box for a plasma processing apparatus according to Claim 30, wherein the high-frequency output terminal is the other end itself of the second reactive element.

35. A plasma processing method for generating plasma within a vacuum chamber and processing a substrate placed on a substrate electrode within the vacuum chamber, the method comprising:

so arranging a straight line passing through a center axis of the high-frequency coupling device, a straight line passing through a center axis of the counter electrode or antenna, and a straight line passing through a center axis of the substrate as to be generally coincident together;

controlling interior of the vacuum chamber to a specified pressure by introducing a gas into the vacuum chamber and, simultaneously therewith, exhausting the interior of the vacuum chamber;

generating the plasma by applying a high-frequency power having a frequency of 50 MHz to 300 MHz to a counter electrode or antenna provided opposite to the substrate via the matching box as defined in Claim 30 and a high-frequency coupling device provided to connect a high-frequency output terminal of the matching box and the

counter electrode or antenna to each other: and
processing the substrate by using the generated
plasma.

36. A plasma processing method according to Claim (35),
further comprising: before controlling the interior of the
vacuum chamber to the specified pressure,

so arranging a straight line passing through a
center axis of the high-frequency output terminal and a
straight line passing through the center axis of the high-
frequency coupling device as to be generally coincident with
each other,

wherein the plasma is generated with the straight
line passing through the center axis of the high-frequency
output terminal and the straight line passing through the
center axis of the high-frequency coupling device being
generally coincident with each other.

37. A plasma processing method according to Claim 35,
further comprising: before controlling the interior of the
vacuum chamber to the specified pressure,

so arranging the first reactive element and the
second reactive element that a straight line passing
through a center axis of the second reactive element and a
straight line passing through a center axis of the first
reactive element are generally coincident with each other,

wherein the plasma is generated with the straight

comprising: before controlling the interior of the vacuum chamber to the specified pressure,

~~arranging the high-frequency output terminal so~~
as to be the other end itself of the second reactive
5 element,

wherein the plasma is generated with the high-frequency output terminal being the other end itself of the second variable capacitor.

44. A plasma processing method according to Claim 40,
10 further comprising: before controlling the interior of the vacuum chamber to the specified pressure,

arranging substantial distance from the other end
of the second variable capacitor to the counter electrode
or antenna to be not more than $1/10$ of wavelength of the
15 high-frequency power,

wherein the plasma is generated with the
substantial distance from the other end of the second
variable capacitor to the counter electrode or antenna to
be not more than $1/10$ of wavelength of the high-frequency
20 power.

45. A plasma processing apparatus comprising:

a vacuum chamber;

a gas supply unit for supplying gas into the
vacuum chamber;

25 an evacuating device for evacuating interior of

the vacuum chamber;

a substrate electrode for placing thereon a
substrate within the vacuum chamber;

a counter electrode or an antenna provided
5 opposite to the substrate electrode;

high-frequency power supply capable of supplying
a high-frequency power having a frequency of 50 MHz to 300
MHz to the counter electrode or antenna;

the matching box as defined in Claim 30; and

10 a high-frequency coupling device for connecting
the high-frequency output terminal of the matching box and
the counter electrode or antenna to each other,

wherein a straight line passing through a center
axis of the high-frequency coupling device, a straight line
15 passing through a center axis of the counter electrode or
antenna, and a straight line passing through a center axis
of the substrate are so arranged as to be generally
coincident together.

46. A plasma processing apparatus according to Claim
20 45, wherein a straight line passing through a center axis of
the high-frequency output terminal and a straight line
passing through the center axis of the high-frequency
coupling device are so arranged as to be generally
coincident with each other.

25 47. A plasma processing apparatus according to Claim

45, wherein the first reactive element and the second reactive element are so arranged that a straight line passing through a center axis of the second reactive element and a straight line passing through a center axis of the first reactive element are generally coincident with each other.

48. A plasma processing apparatus according to Claim 45, wherein the high-frequency output terminal is the other end itself of the second reactive element.

49. A plasma processing apparatus according to Claim 45, wherein substantial distance from the other end of the second reactive element to the counter electrode or antenna is not more than $1/10$ of wavelength of the high-frequency power.

50. A plasma processing apparatus comprising:

a vacuum chamber;

a gas supply unit for supplying gas into the vacuum chamber;

an evacuating device for evacuating interior of the vacuum chamber;

a substrate electrode for placing thereon a substrate within the vacuum chamber;

a counter electrode or an antenna provided opposite to the substrate electrode;

high-frequency power supply capable of supplying

a high-frequency power having a frequency of 50 MHz to 300 MHz to the counter electrode or antenna;

~~the matching box as defined in Claim 30; and~~

a high-frequency coupling device for connecting
5 the high-frequency output terminal of the matching box and the counter electrode or antenna to each other,

wherein a straight line passing through a center axis of the high-frequency coupling device, a straight line passing through a center axis of the counter electrode or
10 antenna, and a straight line passing through a center axis of the substrate are so arranged as to be generally coincident together.

51. A plasma processing apparatus according to Claim 50, wherein the plasma is generated while the straight line passing through the center axis of the high-frequency
15 output terminal and the ~~straight~~ line passing through the center axis of the high-frequency coupling device are so arranged as to be generally coincident with each other.

52. A plasma processing apparatus according to Claim 50, wherein a first variable capacitor and a second variable capacitor are so arranged that a straight line passing through a center axis of the second variable capacitor and a
20 straight line passing through a center axis of the first variable capacitor are generally coincident with each other.

53. A plasma processing apparatus according to Claim

